CLAIMS:

I claim:

1. A spectrometer system, said system comprising:

a spectral instrument wherein said spectral instrument comprises means for detecting optical wavelength energy; means for performing functions upon detected optical energy, said functions performed being those of instruments, said instruments being selected from the group consisting of monochromator, spectroradiometer, spectrophotometer and a spectral energy source; and

power module comprising means for providing to said spectral instrument, operating power, means for communicating, means for interconnecting said spectral instrument with a means for controlling said means for performing functions by said spectral instrument.

2. The spectrometer system according to claim 1 further comprising means for receiving commands from a list of commands and means for responding to each of said commands, said commands of said list of commands consisting of at least one command selected from the group consisting of power on and off, scan wavelengths including selection of start wavelength and end wavelength, read and display measured data, instrument calibration and validation, and cage drive mechanism.

3. The spectrometer system according to claim 1 further comprising software operable on a computer, said software providing means for remotely accessing, controlling functions, controlling performance, and controlling measurement and characterizing of measured data developed by said spectral instrument.

4. The spectrometer system according to claim 2 further comprising software operable on a computer, said software providing means for remotely accessing, controlling functions, controlling

performance, and controlling measurement and characterizing of measured data developed by said spectral instrument.

5. The spectrometer system according to claim 1 further comprising means for comparing data developed by said spectral instrument when performing functions of one of said instruments.

6. The spectrometer system according to claim 2 further comprising means for comparing data developed by said spectral instrument when performing functions of one of said instruments.

7. The spectrometer system according to claim 4 further comprising means for comparing data developed by said spectral instrument when performing functions of one of said instruments.

8. The spectrometer system according to claim 7 further comprising programmable electronics and means to indicate malfunction within said spectral instrument; wherein said means for indicating malfunction comprises at least one indicator light having an on state and an off state and connected to said programmable electronics, and wherein said programmable electronics control said state of said at least one indicator light wherein said state of at least one indicator light is related to said malfunction in said spectral instrument.

9. The spectrometer system according to claim 1 further comprising means to control said means for performing functions wherein said means for control comprises:

a set of commands, each command of said set of commands being transmitted to said means for communicating, wherein each command of said set of commands instructs said spectral instrument to perform a certain function of said functions; and

a micro-computer and control circuitry incorporated into said spectral instrument for receiving said commands, interpreting said commands, and directing said spectral instrument to perform said certain function based on which said command is received.

10. The spectrometer system according to claim 1, wherein said spectral instrument further comprises:

a plurality of optical components, each component of said plurality of optical components being particularly oriented and located each with respect to the others, wherein some selected optical components function to direct and define a plurality of beam paths for an optical beam and other selected optical components function to alter the nature of said optical beams of energy which enter said spectral instrument, each said beam paths are used concurrently and simultaneously and in a non-interfering manner by said optical beam traveling over said beam paths.

11. The spectrometer system according to claim 2, wherein said spectral instrument further comprises:

a plurality of optical components, each component of said plurality of optical components being particularly oriented and located each with respect to the others, wherein some selected optical components function to direct and define a plurality of beam paths for an optical beam and other selected optical components function to alter the nature of said optical beams of energy which enter said spectral instrument, each said beam paths are used concurrently and simultaneously and in a non-interfering manner by said optical beam traveling over said beam paths.

12. The spectrometer system according to claim 4, wherein said spectral instrument further comprises:

a plurality of optical components, each component of said plurality of optical components being particularly oriented and located each with respect to the others, wherein some selected optical components function to direct and define a plurality of beam paths for an optical beam and other selected optical components function to alter the nature of said optical beams of energy which enter said spectral instrument, each said beam paths are used concurrently and simultaneously and in a non-interfering manner by said optical beam traveling over said beam paths.

13. The spectrometer system according to claim 8, wherein said spectral instrument further comprises:

a plurality of optical components, each component of said plurality of optical components being particularly oriented and located each with respect to the others, wherein some selected optical components function to direct and define a plurality of beam paths for an optical beam and other selected optical components function to alter the nature of said optical beams of energy which enter said spectral instrument, each said beam paths are used concurrently and simultaneously and in a non-interfering manner by said optical beam traveling over said beam paths.

14. The spectrometer system according to claim 9, wherein said spectral instrument further comprises:

a plurality of optical components, each component of said plurality of optical components being particularly oriented and located each with respect to the others, wherein some selected optical components function to direct and define a plurality of beam paths for an optical beam and other selected optical components function to alter the nature of said optical beams of energy which enter said spectral instrument, each said beam paths are used concurrently and simultaneously and in a non-interfering manner by said optical beam traveling over said beam paths.

15. A spectral instrument for performing analysis of spectral energy of an input optical beam, said input optical beam having a wavelength distribution and an energy distribution, said spectral instrument comprising:

a first monochromator portion comprising a first entrance slit said first entrance slit in optical beam path relationship with a grating component, a first exit slit in diffracted and wavelength selected beam path relationship with a first reflective surface of said grating component; and

a second monochromator portion comprising a second entrance slit, said second entrance slit being in a mirror image optical beam path relationship with a return mirror and with said grating component, a second exit slit in twice diffracted and twice wavelength selected beam path relationship with a second reflective surface of said grating component, said optical beam paths of said first monochromator portion and said second monochromator portion being substantially non-interfering.

16. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 15 further comprising means for chopping at a predetermined chop rate, any optical beam within both said first monochromator portion and said second monochromator portion, said means for chopping positioned in optical beam path relationship with said first exit slit and said return mirror and said return mirror and said second entrance slit of said second monochromator portion.

17. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 15 further comprising means for moving said grating component thereby selecting the wavelength discriminated by both said first monochromator and said second monochromator.

18. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 16 further comprising means for moving said grating component thereby selecting the wavelength discriminated by both said first monochromator and said second monochromator.

19. A spectral instrument for performing analysis of spectral energy of an input optical beam, said input optical beam having a wavelength distribution and an energy distribution, said spectral instrument comprising:

a first entrance slit upon which an entrance optical beam, derived from said input optical beam, is directed in a first path, said first entrance slit creating thereby a first entrance slit beam, said first entrance slit beam having a cross section dimensions substantially equal to the cross section dimensions of said first entrance slit;

a first location on a prism first reflecting surface upon which said entrance slit beam is directed in a second path, said prism first reflecting surface directs said entrance slit beam on a third path to a grating component, said entrance slit beam thereby being diffracted by said grating component creating a first diffracted beam which first diffracted beam is reflected in a fourth path from said grating component surface to a first location on a prism second reflecting surface;

field lens upon which said first diffracted beam is directed on a fifth path from said prism second reflecting surface focuses and directs said first diffracted beam and a defined and selected portion of the optical spectrum of said first diffracted beam onto a first exit slit, said first exit slit thereby discriminating and producing a narrow bandwidth beam of optical wavelengths;

return mirror upon which said narrow bandwidth beam is directed on a sixth path , said return mirror creating a mirror image beam of said narrow bandwidth beam and directing on a seventh path said mirror image beam to said field lens;

second entrance slit upon which said mirror image beam is directed on an eighth path by said field lens providing discrimination of said mirror image beam;

a second location of said prism second reflecting surface upon which said discriminated mirror image beam is directed, said prism second reflecting surface directs on a ninth path, said discriminated mirror image beam to said grating component, said discriminated mirror image beam being diffracted by said grating component creating a diffracted discriminated mirror image beam which diffracted discriminated mirror image beam is reflected on a tenth path from said grating component surface to a second location on said prism first reflecting surface; and

a second exit slit upon which said second location on said prism first reflecting surface directs on an eleventh path, said diffracted discriminated mirror image beam providing a second discrimination of said diffracted mirror image beam.

20. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 19 further comprising means for chopping at a predetermined chop rate said first diffracted beam and said mirror image beam.

21. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 19 further comprising means for moving said grating component thereby selecting the wavelength discriminated by both said first exit slit and said second exit slit.

22. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 20 further comprising means for moving said grating component thereby selecting the wavelength discriminated by both said first exit slit and said second exit slit.

23. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 19 further comprising:

a turning mirror directing therefrom, said diffracted discriminated mirror image beam into an instrument output portion; and

input optics, said input optics selected from the group consisting of a wide-angle lens, a narrow-angle lens and fiber optics.

24. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 20 further comprising a turning mirror directing therefrom, said diffracted discriminated mirror image beam into an instrument output portion; and

input optics, said input optics selected from the group consisting of a wide-eyed lens, a narrow-eyed lens and fiber optics.

25. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 22 further comprising a turning mirror directing therefrom, said diffracted discriminated mirror image beam into an instrument output portion; and

input optics, said input optics selected from the group consisting of a wide-eyed lens, a narrow-eyed lens and fiber optics.

26. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 23 further comprising:

a detector positioned in said instrument output portion upon which detector said diffracted discriminated mirror image beam is directed;

a detector amplifier for amplifying said detected information; and

means for communicating said amplified detected information to a use of said spectral instrument.

27. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 24 further comprising:

a detector positioned in said instrument output portion upon which detector said diffracted discriminated mirror image beam is directed;

a detector amplifier for amplifying said detected information; and

means for communicating said amplified detected information to a use of said spectral instrument.

28. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 25 further comprising:

a detector positioned in said instrument output portion upon which detector said diffracted discriminated mirror image beam is directed;

a detector amplifier for amplifying said detected information; and

means for communicating said amplified detected information to a use of said spectral instrument.

29. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 27 wherein said detector amplifier is a lock-in amplifier.

30. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 21 further comprising means for optical initialization and a means for verification of wavelength using a known wavelength source directed, on-axis, to said grating component and detected by an initialization detector.

31. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 22 further comprising means for optical initialization and a means for verification of wavelength using a known wavelength source directed, on-axis, to said grating component and detected by an initialization detector.

32. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 25 further comprising means for optical initialization and a means for verification of wavelength using a known wavelength source directed, on-axis, to said grating component and detected by an initialization detector.

33. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 28 further comprising means for optical initialization and a means for verification of wavelength using a known wavelength source directed, on-axis, to said grating component and detected by an initialization detector.

34. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 21 wherein said means for moving said grating component comprises:

a stepping motor having a motor shaft output end; and

a means for automatic caging of said grating during shipping comprising

a fixed anti-backlash magnet having a fixed magnet first opposing side and a fixed magnet second opposing side and a fixed magnet shaft recess, said fixed magnet first opposing side affixed to said motor shaft output end;

a slip-coupled anti-backlash magnet having two opposing sides, a slip magnet first opposing side and a slip magnet second opposing side, and a slip magnet shaft recess, said slip magnet first opposing side facing said fixed magnet second opposing side;

a flexible torsion drive shaft having a proximal end and a distal end, said proximal end disposed within said fixed magnet shaft recess and said slip magnet shaft recess; and

a worm drive at said distal end of said flexible torsion drive shaft, said worm drive engaged with gears such that rotation of said worm drive causes an arcuate movement of said grating.

35. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 22 wherein said means for moving said grating component comprises:

a stepping motor having a motor shaft output end; and

a means for automatic caging of said grating during shipping comprising

a fixed anti-backlash magnet having a fixed magnet first opposing side and a fixed magnet second opposing side and a fixed magnet shaft recess, said fixed magnet first opposing side affixed to said motor shaft output end;

a slip-coupled anti-backlash magnet having two opposing sides, a slip magnet first opposing side and a slip magnet second opposing side, and a slip magnet shaft recess, said slip magnet first opposing side facing said fixed magnet second opposing side;

a flexible torsion drive shaft having a proximal end and a distal end, said proximal end disposed within said fixed magnet shaft recess and said slip magnet shaft recess; and

a worm drive at said distal end of said flexible torsion drive shaft, said worm drive engaged with gears such that rotation of said worm drive causes an arcuate movement of said grating.

36. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 25 wherein said means for moving said grating component comprises:

a stepping motor having a motor shaft output end; and

a means for automatic caging of said grating during shipping comprising

a fixed anti-backlash magnet having a fixed magnet first opposing side and a fixed magnet second opposing side and a fixed magnet shaft recess, said fixed magnet first opposing side affixed to said motor shaft output end;

a slip-coupled anti-backlash magnet having two opposing sides, a slip magnet first opposing side and a slip magnet second opposing side, and a slip magnet shaft recess, said slip magnet first opposing side facing said fixed magnet second opposing side;

a flexible torsion drive shaft having a proximal end and a distal end, said proximal end disposed within said fixed magnet shaft recess and said slip magnet shaft recess; and

a worm drive at said distal end of said flexible torsion drive shaft, said worm drive engaged with gears such that rotation of said worm drive causes an arcuate movement of said grating.

37. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 28 wherein said means for moving said grating component comprises:

a stepping motor having a motor shaft output end; and

a means for automatic caging of said grating during shipping comprising

a fixed anti-backlash magnet having a fixed magnet first opposing side and a fixed magnet second opposing side and a fixed magnet shaft recess, said fixed magnet first opposing side affixed to said motor shaft output end;

a slip-coupled anti-backlash magnet having two opposing sides, a slip magnet first opposing side and a slip magnet second opposing side, and a slip magnet shaft recess, said slip magnet first opposing side facing said fixed magnet second opposing side;

a flexible torsion drive shaft having a proximal end and a distal end, said proximal end disposed within said fixed magnet shaft recess and said slip magnet shaft recess; and

a worm drive at said distal end of said flexible torsion drive shaft, said worm drive engaged with gears such that rotation of said worm drive causes an arcuate movement of said grating.

38. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 31 wherein said means for moving said grating component comprises:

a stepping motor having a motor shaft output end; and

a means for automatic caging of said grating during shipping comprising

a fixed anti-backlash magnet having a fixed magnet first opposing side and a fixed magnet second opposing side and a fixed magnet shaft recess, said fixed magnet first opposing side affixed to said motor shaft output end;

a slip-coupled anti-backlash magnet having two opposing sides, a slip magnet first opposing side and a slip magnet second opposing side, and a slip magnet shaft recess, said slip magnet first opposing side facing said fixed magnet second opposing side;

a flexible torsion drive shaft having a proximal end and a distal end, said proximal end disposed within said fixed magnet shaft recess and said slip magnet shaft recess; and

a worm drive at said distal end of said flexible torsion drive shaft, said worm drive engaged with gears such that rotation of said worm drive causes an arcuate movement of said grating.

39. The spectral instrument for performing analysis of spectral energy of an input optical beam according to claim 32 wherein said means for moving said grating component comprises:

a stepping motor having a motor shaft output end; and

a means for automatic caging of said grating during shipping comprising

a fixed anti-backlash magnet having a fixed magnet first opposing side and a fixed magnet second opposing side and a fixed magnet shaft recess, said fixed magnet first opposing side affixed to said motor shaft output end;

a slip-coupled anti-backlash magnet having two opposing sides, a slip magnet first opposing side and a slip magnet second opposing side, and a slip magnet shaft recess, said slip magnet first opposing side facing said fixed magnet second opposing side;

a flexible torsion drive shaft having a proximal end and a distal end, said proximal end disposed within said fixed magnet shaft recess and said slip magnet shaft recess; and

a worm drive at said distal end of said flexible torsion drive shaft, said worm drive engaged with gears such that rotation of said worm drive causes an arcuate movement of said grating.

40. A method for using a spectral system for measuring and transmitting spectral energy data in the form of a spectrum derived from wavelength data characteristic of a stream of electromagnetic radiation, said spectral system being controlled by a plurality of commands, said spectral system having; at least one function, a plurality of calibration operations, automatic caging capability, manual filter control, and a shutter, said method comprising:

powering up said spectral system; initializing said spectral system; calibrating said spectral system; commanding said spectral system to perform functions comprising; reading said spectral energy data, scanning said spectral energy data, integrating said spectral energy data over time, displaying said spectral energy data, requesting status of said spectral system, stopping an ongoing command, performing automatic caging of means for causing said scanning, reading temperature, calibrating said spectral system, opening shutter, closing shutter, controlling a selection of order sorting filters, and entering "sleep" mode;

receiving from said spectral system, said spectral energy data read by said spectral system;

interpreting said received data; and powering down said system.